

## SILVER-PLATED PANEL MULTIPLE BANK TERMINALS

### METHOD OF MAKING INSULATION RESISTANCE MEASUREMENTS

#### BATTERY CUTOFF PANEL OFFICES

##### 1. GENERAL

1.01 This section covers a method of making insulation resistance measurements on panel multiple banks having silver-plated terminals in battery cutoff panel offices, and is intended only for use where analysis of service failures appears to indicate insulation resistance defects in the banks. The measurements are made between the tip and ring terminals and ring terminal to ground of line finder and final multiple banks and between tip and ring terminals of district and office multiple banks. Detection of low insulation conditions is most effective during humid periods.

1.02 This section is reissued to revise the tests generally and to put them in tabular form. Issue 1 of this section was provisional and did not receive general distribution. Since this reissue covers a general revision, the arrows ordinarily used to indicate changes have been omitted.

1.03 The tests covered are:

##### A. Measurement of Line Finder and Final Multiple Bank Terminals:

This test provides for the measurement of line finder and final multiple banks. Since the line finder bank terminals are in multiple with the associated final bank terminals, the conductors, and station equipment, the initial bank tests are made as a common measurement. In making these measurements a manual electronic-type subscriber line insulation test set is suggested as well as a 150-volt, 150,000-ohm voltmeter and 100-volt battery.

##### B. Measurement of District Multiple Bank Terminals Connected to 3-wire Office Selectors:

This test provides for a measurement of the district multiple bank terminals connected to 3-wire office selectors, using a 150-volt, 150,000-ohm voltmeter and a 100-volt battery and testing at the 3-wire office selector test jacks.

##### C. Measurement of District or Office Multiple Bank Terminals Accessible From OCT Test Panel:

This test provides for a measurement of those portions of the district and office

multiple accessible to OCT test panels using a 150-volt, 150,000-ohm voltmeter and 100-volt battery.

1.04 The initial measurements called for in Test A are a common measurement of the line finder bank terminals, the final bank terminals, and the conductors and station equipment associated with the line under test. Similarly, the initial measurements called for in Tests B and C are common measurement of all district or all office bank terminals which are connected in multiple. In no case should the multiple between banks be opened unless the initial measurement gives evidence of a leak which is in a range to affect service and only after it has been determined that the leak is in the central office equipment. For the purpose of these tests, such a leak is considered to be 150,000 or less resistance between terminals of an individual multiple bank.

1.05 Part of the procedure in Test A is based on the use of the H-297-421 electronic-type subscriber line insulation test set connected to a test shoe which is arranged to make a sliding contact with the tip, ring, and sleeve terminals on IDF terminal strips. However, other facilities of the same general type which will give equivalent results may be employed, if they are more readily available and if the same general procedure is followed.

1.06 The H-297-421 test set is not arranged to test first or intermediate lines of PBX groups or any busy lines. Since the test of a line is indicated by the lighting of the CT lamp of the test set, failure of this lamp to light on non-PBX lines or the last line of a PBX group indicates a busy condition. In such cases, these lines should be retested when they become idle.

1.07 The line insulation test set is arranged to make tests in four ranges. However, Test A specifies the use of only the A range. Under these circumstances the lighting of the red, yellow, or green lamp on the test set indicates resistance measurements between tip and ring or ring to ground as follows:

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Red - Less than 0.04 megohm (40,000 ohms)

Yellow - 0.04 to 0.07 megohm (40,000 to 70,000 ohms)

Green - 0.07 to 0.15 megohm (70,000 to 150,000 ohms)

Each line on which a test failure is encountered should be marked by placing on the line or equipment terminal a red, yellow, or green signal indicator corresponding to the color of the trouble indication on the test set, and then proceeding with the test of the remaining lines.

1.08 Test A requires that the local test center force determine whether any trouble encountered in using the line insulation test set locates toward the central office equipment. When this has been determined, local procedures should be followed in deciding when further testing can be done since the method is based on opening the subscriber line and making the line busy to incoming calls until such time as the failure has been located. The local test center should be notified and local procedures should be followed when testing is completed, to determine that the line is satisfactory for service.

1.09 In Test A, in determining the particular multiple bank in which a failure locates, one or more of the following conditions may be encountered. A subscriber line may be associated with silver-plated bank terminals in:

- (a) A single line finder multiple bank
- (b) A single final multiple bank
- (c) Both line finder and final multiple banks
- (d) Two or more banks, either line finder or final, connected in multiple

Portions of the procedure for Test A have been designated in accordance with these conditions so as to identify the testing method to be followed for each.

1.10 Resistance measurements in part of Test A and in Tests B and C are made with a 150-volt, 150,000-ohm voltmeter in series with a 100-volt  $\pm 1$  volt test battery and a suitable test cord which is applied across the terminals to be tested. When determining whether the resistance being checked is 150,000 ohms or less, consideration must be given to the test battery voltage. If the test battery voltage is 99 volts, a voltmeter reading of 49.5 volts indicates a resistance of 150,000 ohms if the test battery voltage is 100 volts, a voltmeter reading of 50 volts indicates a resistance of 150,000 ohms; if the test

battery voltage is 101 volts a voltmeter reading of 50.5 volts indicates a resistance of 150,000 ohms. For the purpose of these tests the voltage used is considered to be 100 volts.

1.11 The initial resistance measurements in Test B are made at the test (or test and make-busy) jacks of the 3-wire office selectors which are connected to the district multiple to be tested.

1.12 The initial resistance measurements in Test C are made at the OGT test jacks which are connected to the district or office multiple terminals to be tested.

1.13 When performing Test B or Test C, only as many office selectors or trunks as traffic conditions will permit should be made busy at one time. In no case should an entire group of office selectors or trunks be made busy at one time, nor should a make-busy plug be inserted in an MB or TMB jack while the associated office selector circuit is busy on a service call.

1.14 If the result of a test indicates that a failure is within the central office but not in a multiple bank, refer the matter to the supervisor.

1.15 Where the 150-volt voltmeter and 100-volt battery are used and the terminals being checked are above shoulder level it is suggested that a ladder seat be utilized and the voltmeter and battery secured to it.

1.16 Lettered Steps: The letters a, b, c, etc., are added to a step number to indicate that the steps cover an action which may or may not be required, depending on local conditions. The conditions under which a lettered step or series of steps should be made are given in the action column, and all steps governed by the same condition are designated by the same letter. Where a condition does not apply the associated step should be omitted.

## 2. APPARATUS

### Tests A, B, and C

2.01 No. 893 cord, 6 feet long, equipped with two No. 360A tools (1W13B cord) and a No. 411A tool at one end and a No. 364 tool at the other end, two required.

2.02 Weston Model No. 1 Voltmeter 150/75/3-V, 1000 ohms per volt or equivalent.

2.03 100-volt  $\pm 1$  volt dry battery.

2.04 Lengths of cross-connection wire or equivalent as required to connect batteries.

Test A

- 2.05 Test set H-297-421 (ST 627579) subscriber line insulation, electronic type with sleeve supervision.
- 2.06 Test shoe H-297-421, List 6.
- 2.07 P2J cord, 9 feet long equipped with two 310-type plugs (2P9A cord).
- 2.03 No. 319D plugs, as required, for use when the MDF is equipped with 444-type jacks.
- 2.09 WIP cord, 12 feet long, equipped with No. 1C plug (1W4A cord) (PBX make-busy cord).
- 2.10 No. 1A (red), 2A (yellow), and 3A (green) signal trouble indicators, as required.

Tests B and C

- 2.11 W2W cord, 10 feet long equipped with a 310-type plug, a No. 360B tool, a No. 360C tool (2W17C cord), and a No. 364

tool and a KS-6278 connecting clip. (Always used in Test B and used in Test C when the OGT test panel is equipped with 49- or similar-type jacks.)

Test B

- 2.12 No. 184B plugs, as required.
- 2.13 No. 267B tools, as required.

Test C

- 2.14 No. 322A plugs, as required (for use when the OGT test panel is equipped with 92- or similar-type jacks).
- 2.15 No. 184B plug, as required (for use when the OGT test panel is equipped with 49- or similar-type jacks).
- 2.16 No. 319D plugs, as required (for use when the MDF is equipped with 444-type jacks).
- 2.17 W2BB cord, 5 feet long, equipped with a 309-type plug (2W25A cord) (for use when the OGT test panel is equipped with 92- or similar-type jacks).

3. PREPARATIONSTEPACTIONVERIFICATIONPreparation for Test A

- 1 Connect, align, and calibrate the subscriber line insulation test set in accordance with approved methods
- 2 Arrange test set for tip and ring short and/or ring ground test, A range, battery cutoff office in accordance with approved methods
- 3 Connect the portable voltmeter and the 100-volt test battery in series with the 1W13B cord, observing proper polarity of the battery connections and using the 150-volt scale of the voltmeter

Preparation for Test B

- 1 Connect the portable voltmeter and the 100-volt test battery in series with the 2W17C cord, observing proper polarity of the battery connections and using the 150-volt scale of the voltmeter (above cord referred to as voltmeter test cord)

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| STEP | ACTION | VERIFICATION |
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Preparation for Test C

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|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 1 | Connect the portable voltmeter and the 100-volt test battery in series with the 2W17C cord, if the OGT test panel is equipped with 49- or similar-type jacks, or the 2W25A cord, if the OGT test panel is equipped with 92- or similar-type jacks, observing the polarity of the battery connections and using the 150-volt scale of the voltmeter (above cord referred to as voltmeter test cord) |  |
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4. METHOD

| STEP | ACTION | VERIFICATION |
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A. Measurement of Line Finder and Final Multiple Bank Terminals

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|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 4 | At IDF -<br>Test subscriber lines in banks involved and mark terminals on which there are failure indications, by placing on the line terminal, which indicated a test failure, a red, yellow or green signal trouble indicator corresponding to the color of the trouble indicator of the test set.                           | CT lamp lights for each idle line tested.<br>R, Y, or G lamp lights and appropriate buzzer tone is heard for each failure encountered. |
| 5 | Arrange with local test center force to determine whether failures are tip to ring or ring to ground leaks and test in or out of the central office. On each failure which tests in, and which is 150,000 ohms or less, proceed as in Steps 6 through 33 (See 1.08). If failure tests out, refer the matter to the supervisor. |                                                                                                                                        |
| 6 | At HIDF -<br>When the line to be tested is idle--<br>Connect sleeve of line to a PBX make-busy jack using the PBX make-busy cord.                                                                                                                                                                                              |                                                                                                                                        |

Method of Measurement When the Only Silver-plated Terminals Associated With the Line Are in a Single Line Finder or a Single Final Multiple Bank

- |    |                                                                                                        |                                                                                   |
|----|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 7  | At the bank involved -<br>Remove ring wire from end of multiple bank                                   |                                                                                   |
| 8a | If ring to ground failure was indicated -<br>Obtain voltmeter reading between ring terminal and ground | 50 volts or more indicates failure in multiple bank<br>Refer matter to supervisor |
| 9b | If tip to ring failure was indicated -<br>Obtain voltmeter reading between tip and ring terminals      | 50 volts or more indicates failure in multiple bank<br>Refer matter to supervisor |
| 10 | Reconnect and solder the wire removed                                                                  |                                                                                   |
| 11 | Remove PBX make-busy cord at the HIDF                                                                  |                                                                                   |
| 12 | Repeat Steps 6 through 11 for remaining lines to be tested                                             |                                                                                   |

| <u>STEP</u>                                                                                                                    | <u>ACTION</u>                                                                                                                                                                    | <u>VERIFICATION</u>                                                 |
|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <u>Method of Measurement When Line Is Associated With Silver-plated Terminals in Both Line Finder and Final Multiple Banks</u> |                                                                                                                                                                                  |                                                                     |
| 13                                                                                                                             | At VMDF -<br>Open the tip and ring conductors of the line under test by removing the heat coils or, where 444-type jacks are furnished, open the circuit using the No. 319D plug |                                                                     |
| 14                                                                                                                             | At the VIDF -<br>Remove the ring cross connection                                                                                                                                |                                                                     |
| 15a                                                                                                                            | If ring to ground failure was indicated -<br>Obtain voltmeter reading between ring terminal and ground                                                                           | 50 volts or more indicates failure toward line finder bank or banks |
| 16a                                                                                                                            | Obtain voltmeter reading between ring wire of the cross connection removed at the VIDF and ground                                                                                | 50 volts or more indicates failure toward final bank or banks       |
| 17b                                                                                                                            | If tip to ring failure was indicated -<br>Obtain voltmeter reading between the tip and ring terminals at the VIDF                                                                | 50 volts or more indicates failure toward line finder bank or banks |
| 18b                                                                                                                            | Obtain voltmeter reading between the tip and ring wires of the cross connection at the VIDF                                                                                      | 50 volts or more indicates failure toward final bank or banks       |
| 19                                                                                                                             | Reconnect and solder cross-connection wire removed                                                                                                                               |                                                                     |
| 20                                                                                                                             | At VMDF -<br>Replace heat coils or where 444-type jacks are furnished remove the No. 319D plugs                                                                                  |                                                                     |
| 21c                                                                                                                            | If failure locates toward a single line finder bank or a single final bank as indicated in Step 15a, 16a, 17b, or 18b -<br>Proceed as covered in Steps 7 through 11              |                                                                     |
| 22d                                                                                                                            | If the failure locates toward two or more line finder banks in multiple or two or more final banks in multiple<br>Proceed as covered in Steps 24 through 33                      |                                                                     |
| 23                                                                                                                             | Repeat Steps 13 through 22d for remaining lines to be tested                                                                                                                     |                                                                     |

Method of Measurement When Line Is Associated With Silver-plated Terminals in Two or More Line Finder Banks in Multiple or Two or More Final Banks in Multiple

- |    |                                                                                                                                                                                           |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24 | At line finder or final bank -<br>Open the ring connection to the IDF                                                                                                                     |
| 25 | At line finder or final multiple -<br>Open the ring connection at a point which will divide approximately in half that portion of the multiple equipped with silver-plated bank terminals |

| <u>STEP</u> | <u>ACTION</u>                                                                                                                                                                              | <u>VERIFICATION</u>                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| 26a         | If ring to ground failure was indicated - Obtain voltmeter readings between ring terminal and ground of each portion of the multiple to determine the portion in which the failure locates | 50 volts or more indicates direction of failure |
| 27b         | If tip to ring failure was indicated - Obtain voltmeter readings between tip and ring terminals of each portion of the multiple to determine the portion in which the failure locates      | 50 volts or more indicates direction of failure |
| 28          | Open the ring connection at a point which will divide approximately in half the portion in which the failure locates                                                                       |                                                 |
| 29          | Continue as in Steps 26a, 27b, and 28 until the failure has been located                                                                                                                   |                                                 |
| 30          | Record the location of bank or banks in which failure locates and refer to the supervisor                                                                                                  |                                                 |
| 31          | Reconnect and solder all wires removed                                                                                                                                                     |                                                 |
| 32          | At the HIDEF - Remove the PBX make-busy cord                                                                                                                                               |                                                 |
| 33          | Repeat Steps 24 through 32 for remaining lines to be tested                                                                                                                                |                                                 |

B. Measurement of District Multiple Bank Terminals  
Connected to 3-wire Office Selectors

- 2 At office frames -  
Make busy the office selectors associated with the district multiple terminals to be tested
- 3 Remove battery and ground from the tip and ring of the terminals to be tested by insulating the proper sequence switch cams of the associated office selectors using No. 257B contact spring insulators
- 4a If the office selectors are equipped with individual test and make-busy jacks -  
Insert plug of voltmeter test cord into T jack of circuit to be tested
- 5b If the office selector is equipped with a combination test and make-busy jack -  
Remove make-busy plug from TMB jack of circuit to be tested and immediately insert plug of voltmeter test cord
- 6 Record voltmeter reading
- 7 Remove plug of voltmeter test cord from T (or TMB) jack

| <u>STEP</u> | <u>ACTION</u>                                                                                                                                                                                                                                            | <u>VERIFICATION</u>                             |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| 8b          | If the office selector is equipped with a combination test and make-busy jack -<br>Replace make-busy plug                                                                                                                                                |                                                 |
| 9           | Repeat Steps 4a through 8b until the remaining district multiple terminals have been tested                                                                                                                                                              |                                                 |
| 10c         | On circuits where voltmeter reading was <u>less than 50 volts</u> -<br>Remove No. 267B tools from sequence switch springs of associated office selector and remove make-busy plug                                                                        |                                                 |
| 11d         | On circuits where voltmeter reading was <u>50 volts or more</u> -<br>Substitute the 1W13B cords equipped with No. 411A tools for the 2W17C cord in the portable voltmeter test circuit                                                                   |                                                 |
| 12d         | At district multiple -<br>Open the ring multiple connected to the office selector under test by removing the multiple cabling at a point which will divide approximately in half that portion of the multiple equipped with silver-plated bank terminals |                                                 |
| 13d         | Obtain voltmeter readings between tip and ring terminals of each portion of the multiple in turn, to determine the portion in which the failure locates                                                                                                  | 50 volts or more indicates direction of failure |
| 14d         | Open the ring multiple at a point which will divide approximately in half the portion in which the failure is located                                                                                                                                    |                                                 |
| 15d         | Continue as in Steps 13d and 14d until the failure has been located<br>Record the location of the frame, bank, and terminal and refer to the supervisor                                                                                                  |                                                 |
| 16d         | Reconnect and solder all wires removed                                                                                                                                                                                                                   |                                                 |
| 17d         | Repeat Steps 12d through 16d on remaining terminals on which voltmeter readings of 50 volts or more were recorded                                                                                                                                        |                                                 |
| 18d         | At office frame -<br>Remove No. 267B tools from sequence switch springs of office selector circuit tested                                                                                                                                                |                                                 |
| 19d         | Restore to normal any office selector left off-normal as a result of the tests                                                                                                                                                                           |                                                 |
| 20d         | Remove make-busy plugs from circuits tested                                                                                                                                                                                                              |                                                 |

STEPACTIONVERIFICATIONC. Measurement of District or Office Multiple Bank  
Terminals Accessible From OGT Test Panel

- |     |                                                                                                                                                                                                                                                                                                                       |                                                    |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| 2   | At OGT test panel -<br>Make busy the terminals to be tested,<br>provided the associated trunks are<br>idle                                                                                                                                                                                                            |                                                    |
| 3   | At MDF -<br>Disconnect equipment from terminals<br>to be tested<br><br><u>Note:</u> This will require removal of<br>heat coils or opening of the 444-type<br>jacks at the MDF for the cable pair<br>involved, or, in the case of local<br>trunks, the removal of the ring wire<br>of the cross connection at the HMDF |                                                    |
| 4   | At OGT test panel -<br>Insert plug of portable voltmeter<br>test cord into test jack of a terminal<br>to be tested                                                                                                                                                                                                    |                                                    |
| 5   | Record voltmeter reading                                                                                                                                                                                                                                                                                              |                                                    |
| 6   | Remove plug of portable voltmeter<br>test cord                                                                                                                                                                                                                                                                        |                                                    |
| 7   | Repeat Steps 4 through 6 until the<br>remainder of the terminals have been<br>tested                                                                                                                                                                                                                                  |                                                    |
| 8a  | On circuits where voltmeter reading<br>was <u>less than 50 volts</u> -<br>At MDF -<br>Reconnect equipment to associated<br>terminals                                                                                                                                                                                  |                                                    |
| 9a  | At OGT -<br>Make test call on each trunk<br>reconnected                                                                                                                                                                                                                                                               | Test call completes satisfactorily                 |
| 10a | Remove make-busy plug from trunk<br>tested                                                                                                                                                                                                                                                                            |                                                    |
| 11b | On circuits where voltmeter reading<br>was <u>50 volts or more</u> -<br>Substitute the 1W13A cords equipped<br>with No. 411A tools for the plug-<br>ended cord on the portable voltmeter<br>test circuit                                                                                                              |                                                    |
| 12b | At district or office multiple -<br>Open the ring of the multiple under<br>test by removing the multiple cabling<br>at a point which will divide approxi-<br>mately in half that portion of the<br>multiple equipped with silver-plated<br>terminals                                                                  |                                                    |
| 13b | Obtain voltmeter readings between<br>tip and ring terminals of each por-<br>tion of the multiple in turn to<br>determine the portion in which the<br>failure locates                                                                                                                                                  | 50 volts or more indicates direction<br>of failure |



| <u>STEP</u> | <u>ACTION</u>                                                                                                                                           | <u>VERIFICATION</u>                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 14b         | Open the ring multiple at a point which will divide approximately in half the portion in which the failure is located                                   |                                    |
| 15b         | Continue as in Steps 13b and 14b until the failure has been located<br>Record the location of the frame, bank, and terminal and refer to the supervisor |                                    |
| 16b         | Reconnect and solder all wires removed                                                                                                                  |                                    |
| 17b         | At MDF -<br>Reconnect equipment to associated terminal                                                                                                  |                                    |
| 18b         | At OGT -<br>Make test call on each trunk<br>reconnected                                                                                                 | Test call completes satisfactorily |
| 19b         | Remove make-busy plug from trunk<br>tested                                                                                                              |                                    |
| 20b         | Repeat Steps 12b through 19b on remaining terminals on which voltmeter readings of 50 volts or more were recorded                                       |                                    |

